Overview Of The IECC with the 2001 Supplement

Eric Makela, International Conference of Building Officials

Overview of The IECC Commercial Provisions

Commercial Provisions

- Anything Other Than
  - Detached One- and Two Family Dwellings
  - Multi Family Three Story or Less

What is the IECC?

- Enables effective use of energy in new building construction
- Regulates design and selection of:
  - Building envelope
  - Mechanical systems
  - Electrical power and lighting systems
  - Service water heating systems

Structure of the IECC-Commercial

- Chapter 1 Administrative & Enforcement
- Chapter 2 Definitions
- Chapter 3 Design Conditions
- Chapter 4 Residential - Systems Analysis
- Chapter 5 Residential - Component Performance
- Chapter 6 Simplified Prescriptive Requirements
- Chapter 7 ASHRAE 90.1-1999 Energy Code Reference
- Chapter 8 Design by Acceptable Practice for Commercial Buildings
- Chapter 9 Referenced Standards

What is the 90.1 Code?

- ASHRAE/IESNA 90.1-1999
- Latest Standard Published by ASHRAE
- Referenced in Chapter 7 of the IECC

Relevant Sections Structure of 90.1 Code

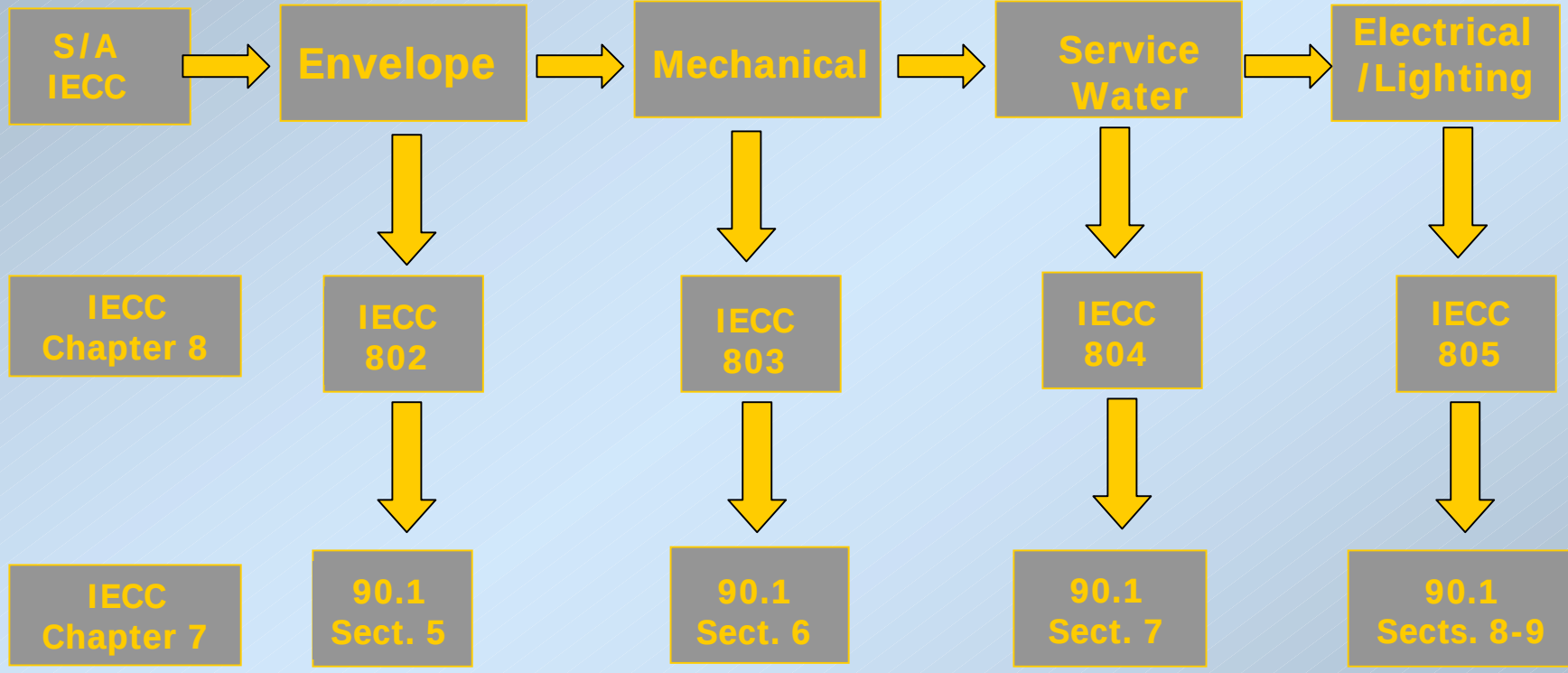
Note: Chapter 1 of IECC takes precedent over Section 2 of 90.1-99

- Section 5 Building Envelope
- Section 6 Heating, Ventilating and Air Conditioning
- Section 7 Service Water Heating
- Section 8 Power
- Section 9 Lighting
- Section 10 Other Equipment
- Section 11 Energy Cost Budget Method

Relevant Sections Structure of 90.1 Code

- Appendix A — Assembly U-Factor, C-Factor, and F-Factor Determination
- Appendix B — Building Envelope Criteria
- Appendix C — Building Envelope Trade-Off Options
- Appendix D — Climate Data

IECC Energy Code Layout

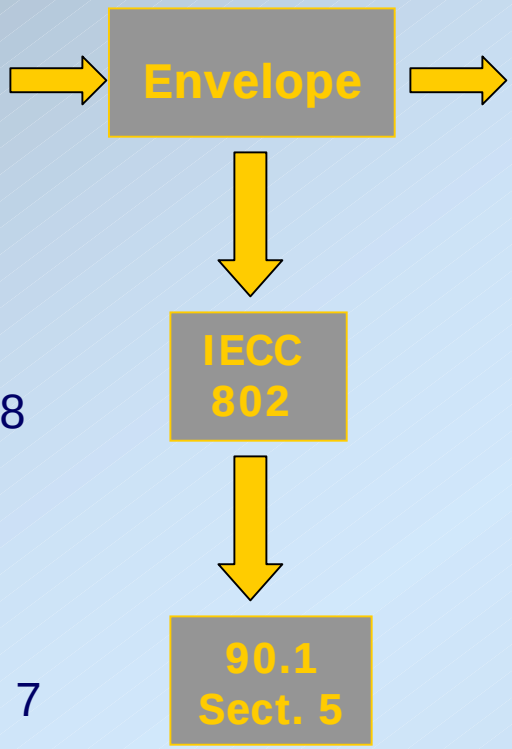


Application

When does the IECC apply?

- Newly-conditioned space
- New construction in existing buildings
- Alterations to existing spaces and buildings
- Additions
- Mixed use buildings

Chapter 8 Scope



IECC Chapter 8

IECC Chapter 7

≤50 % glazing area

IECC Scope

Envelope Requirements:

- Mandatory Requirements
- Air Leakage
- Materials & Equipment Information
- Vapor Retarders

Building Envelope Requirements

Infiltration Controls

Air Tight Recessed Fixture

Vapor Retarders

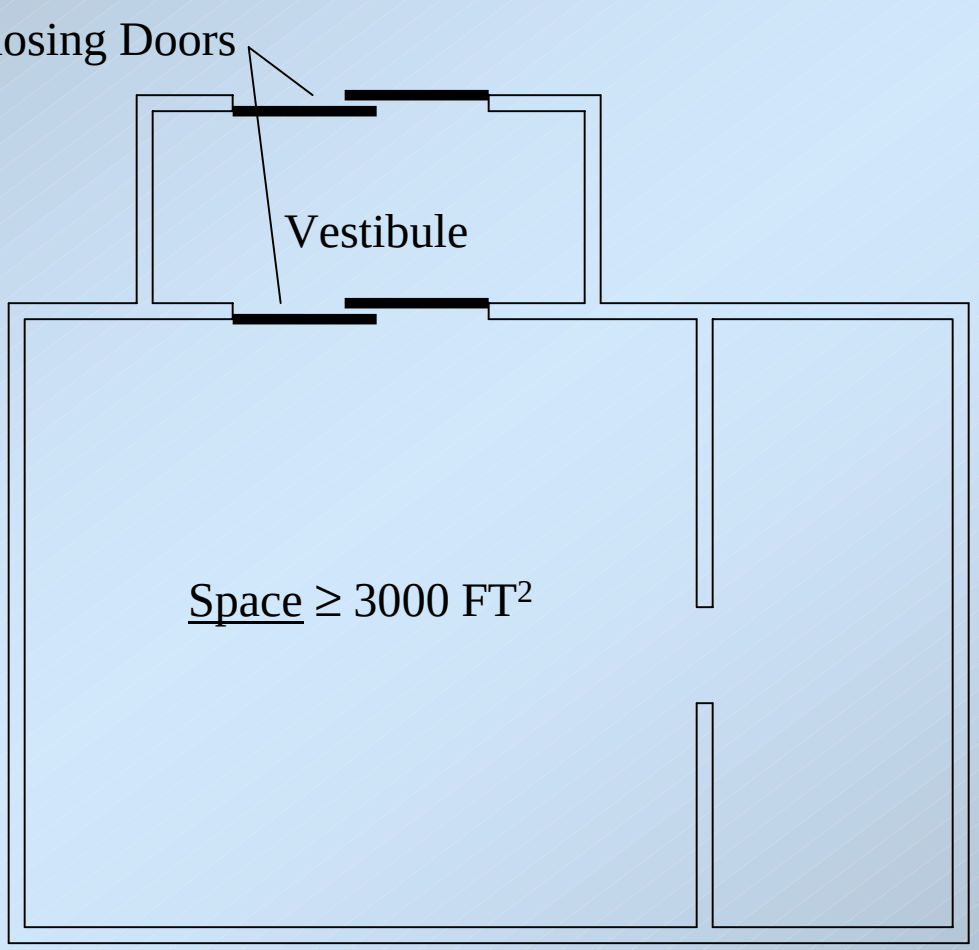
Vestibules

Enclosed Vestibule Required for:

- Spaces ≥ 3,000 Ft2
- Entrance doors
- Must have self-closing devices

Exceptions

- Doors from guest room or dwelling unit
- Revolving doors
- Doors used primarily for vehicular movement, material handling and adjacent personnel doors



Other Infiltration Controls

Dampers Integral to Building Envelope

- Motorized dampers required on vents for
  - Stairs
  - Elevator shafts
  - Other dampers
- Gravity dampers permitted on buildings

< 3 stories

Loading Dock Weatherseals

- Equip cargo doors and loading dock doors with weatherseals
  - Restrict infiltration

Materials and Equipment Information

- Identify materials and equipment used for compliance
  - Building Plans
    - U-factors of windows and doors
    - SHGC of windows
    - R-values of all insulation
    - Window dimensions on floor plans or window schedule

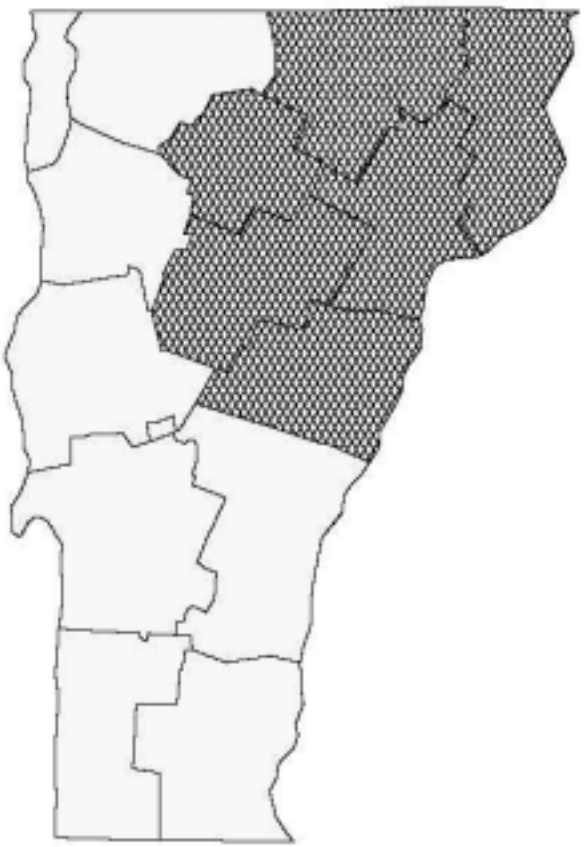
Materials and Equipment Information

- Building Site
  - Labels on insulation and windows
  - Contractor certification statements
  - Blown-in insulation
    - Initial installed and settled thickness
    - Coverage area and number of bags
    - Insulation thickness markers

Building Envelope Requirements

- For buildings ≤ 50% glazing to gross wall area
- Minimal calculations
- Based on:
    - Climate zone
    - Window wall ratio
    - Construction assembly
- All components must meet or exceed building envelope requirements
    - Projection Factors

Vermont



Zone	County
15	Addison
15	Bennington
16	Caledonia
15	Chittenden
16	Essex
15	Franklin
15	Grand Isle
16	Lamoille
16	Orange
16	Orleans
15	Rutland
16	Washington
15	Windham
15	Windsor

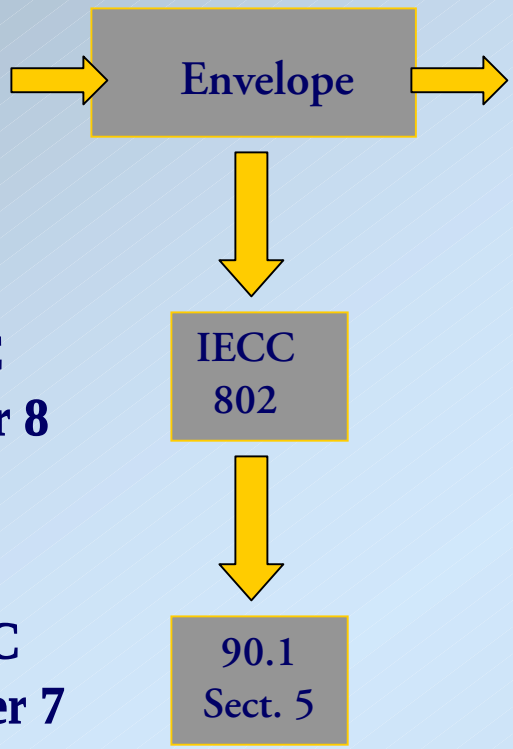
FIGURE 302.1(46)
VERMONT

IECC Table

TABLE 802.2(33)—continued
BUILDING ENVELOPE REQUIREMENTS[a through e] - CLIMATE ZONE 15

WINDOW AND GLAZED DOOR AREA OVER 25 PERCENT BUT NOT GREATER THAN 40 PERCENT OF ABOVE-GRADE WALL AREA			
ELEMENT	**CONDITION/VALUE**		
Skylights (*U*-factor)	0.6		
Slab or below-grade wall (*R*-value)	R-8		
Windows and glass doors	**SHGC**	***U*-factor**	
PF < 0.25	0.5	0.4	
0.25 ≤ PF < 0.50	0.6	0.4	
PF ≥ 0.50	0.7	0.4	
Roof assemblies (*R*-value)	**Insulation between framing**	**Continuous insulation**	
All-wood joist/truss	R-30	R-23	
Metal joist/truss	R-30	R-24	
Concrete slab or deck	NA	R-23	
Metal purlin with thermal block	X	R-24	
Metal purlin without thermal block	X	R-24	
Floors over outdoor air or unconditioned space (*R*-value)	**Insulation between framing**	**Continuous insulation**	
All-wood joist/truss	R-25	R-22	
Metal joist/truss	R-30	R-23	
Concrete slab or deck	NA	R-22	
Above-grade walls (*R*-value)	**No framing**	**Metal framing**	**Wood framing**
Framed			
R-value cavity	NA	R-13	R-11
R-value continuous	NA	R-3	R-0
CMU, ≥ 8 in, with integral insulation			
R-value cavity	NA	R-11	R-11
R-value continuous	R-5	R-0	R-0
Other masonry walls			
R-value cavity	NA	R-13	R-11
R-value continuous	R-6	R-0	R-0

Chapter 7 Scope



IECC Chapter 8

IECC Chapter 7

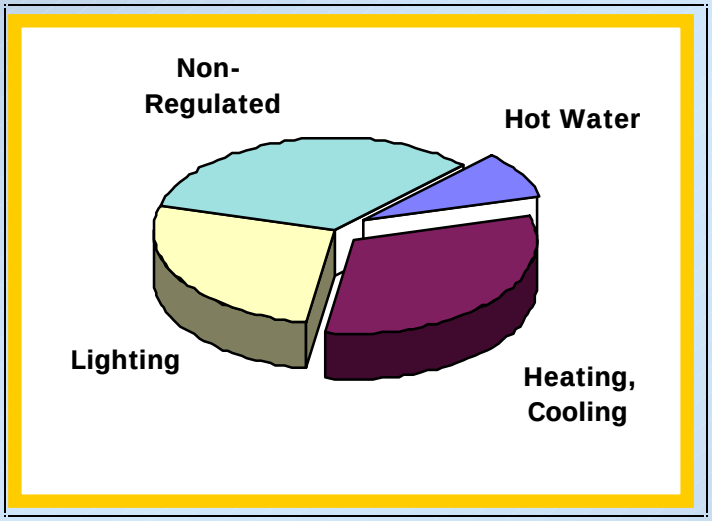
>50% glazing area

90.1 – Section 5

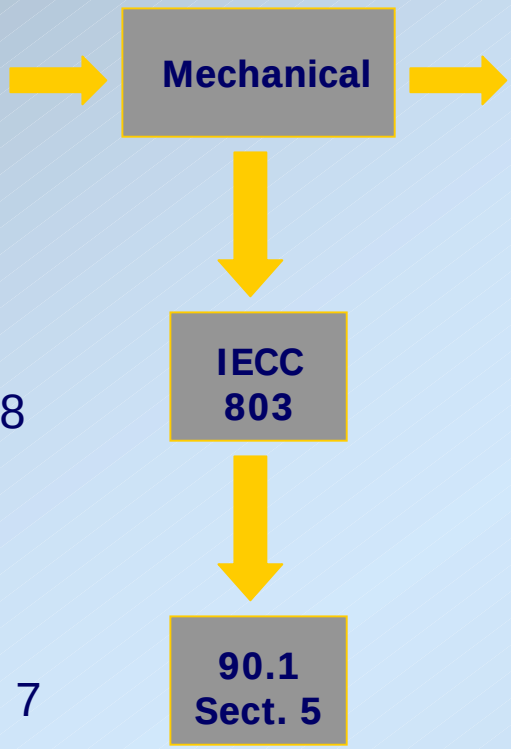
- Prescriptive Requirements
- ENVSTD-Envelope Standard

Mechanical Systems (Application)

- Systems that provide heating, cooling or ventilation *primarily* for human comfort
- Exception: Systems that serve an industrial process

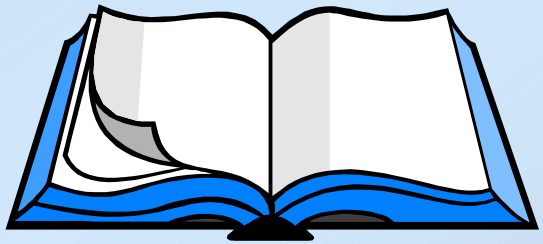


Scope: Chapter 8



- Unitary, Single Zone
- VAV Multiple Zones
- 4-Pipe Hydronic Systems for Heating and Cooling
- Hydronic Heat Pump with Central Plant

Energy Efficient Mechanical Design



IECC accomplishes by:

- Requiring minimum equipment performance
- Minimizing distribution losses
- Optimizing system controls
- Taking advantage of free cooling
- Requiring acceptable levels of outdoor ventilation

Scope: System Types

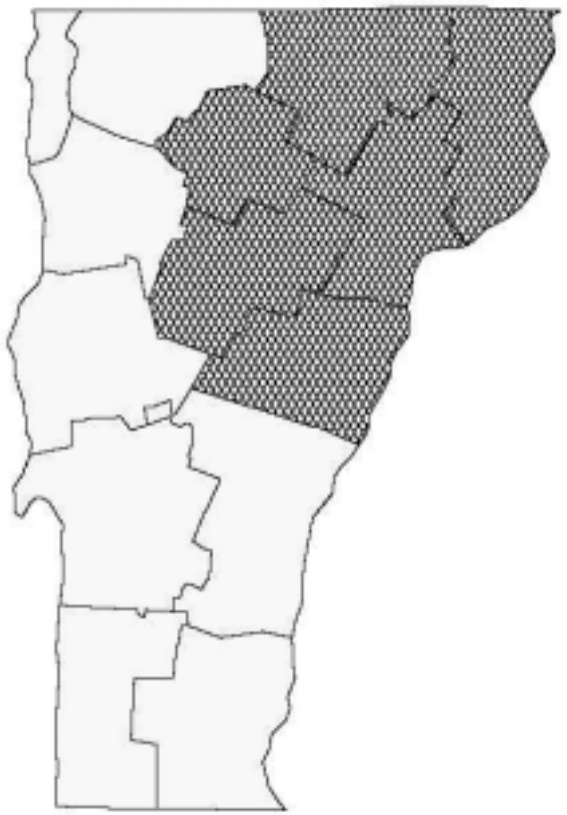
Simple HVAC Systems

Complex HVAC Systems

Economizers

- Not required in zones 1a, 1b, 2a, 2b, 3b
- Air economizers required on systems
- Cooling capacity > 65,000 Btu/h
- Not required to be *integrated*
- Equipment Economizer Exception

Economizers



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16	Washington
15	Windham
15	Windsor

Zone 15
Zone 16

FIGURE 302.1(46)
VERMONT

A 135,000 Btu/h unitary cooling system with a 10.5 EER is proposed for a building in Burlington Vermont (climate zone 15).

Is an economizer required

Duct Construction

Two key areas of energy loss in duct work:

- Insulation
  - R5 – Unconditioned Space
  - R8 – Outside Building Envelope
- Sealing
  - $\leq$ 3 in W.g. – sealed with mastics, mastics – plus embedded fabric, welds, gaskets
  - > 3 in W.g. – leak tested

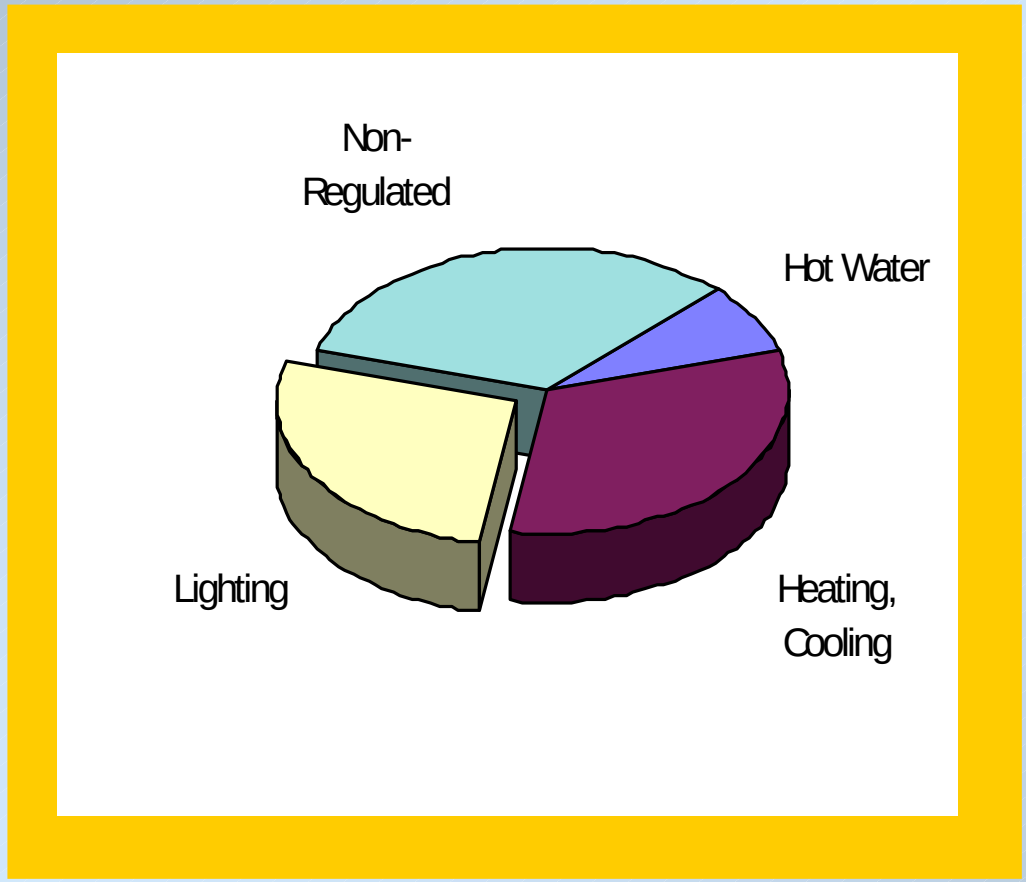
HVAC Equipment Efficiencies

- Increased heating and cooling efficiencies on commercial sized equipment
  - Effective October 29, 2001
- Effects
  - Air conditioners, air cooled $\geq$ 65,000 Btu/H
  - Air conditioners, water and evaporatively cooled – all sizes
  - Heat pumps – most sizes
    - No changes on < 65,000 Btu/Hr
  - PTAC and PTAH Equipment
  - Warm Air Furnaces
    - Gas and oil fired
  - Boilers – reduction in some boiler efficiency requirements
  - Chillers

Heat Rejection Equipment Fan Speed Control

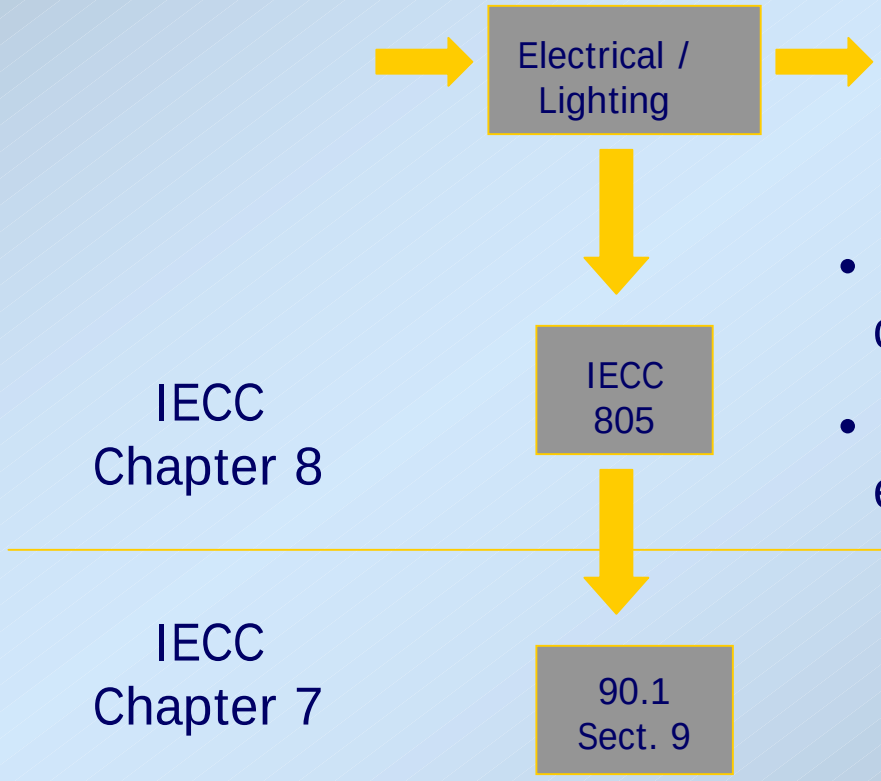
- Fan Motors $\geq$ 7.5 HP
  - Capability to operate at $\leq$ 2/3 of full speed
  - Controls to automatically change fan speed to control
    - Leaving fluid temperature, or
    - Condensing temperature/pressure of heat rejection device

Lighting System Scope



Energy For Lighting in Buildings Accounts for approximately 27% of Energy Use

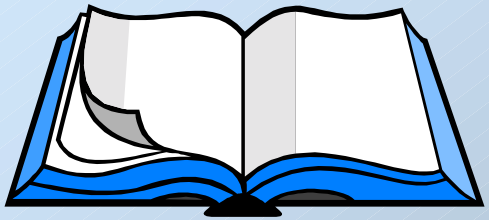
Chapter 8 Scope



- No lighting control credits
- High efficiency exterior lighting

Scope

- Applies to the design of:
  - First installed lighting systems
  - Altered system that increases the lighting load or replaces 50% or more of system



- Lighting systems used for specialized commercial, display and emergency use purposes are exempt (Section 805.4)

Scope

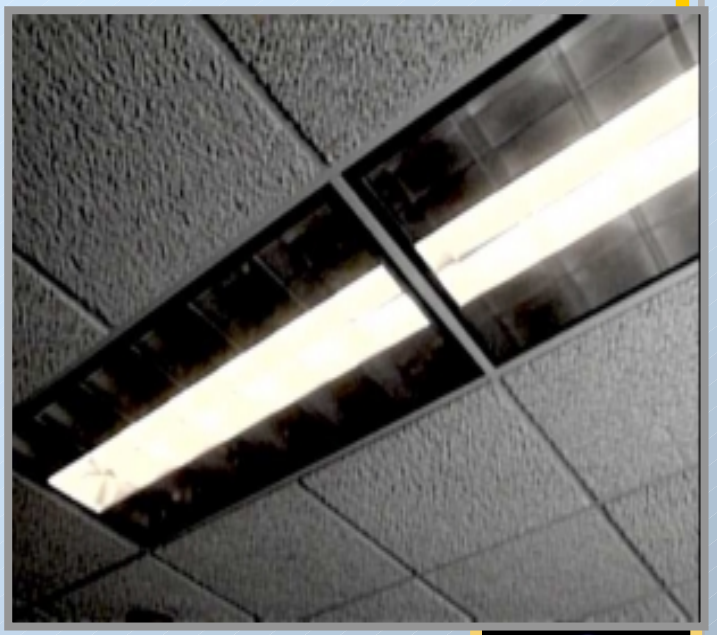
Interior Lighting Requirements:

Mandatory Requirements:
- Controls
- Switching
- Wiring

Interior Lighting Power Requirements

Entire Building

Partial Building



Switching Requirements

- First Requirements
  - Each space to have manual control
- Second Requirement
  - Area < 250 ft^2
    - 2nd Control to reduce lighting load by 50%
  - Area > 250 ft^2 in buildings larger than 5000 ft^2
    - Automatic control device
      - Scheduled basis to control areas $\leq$ 25,000 ft^2 or no more than one floor
      - Unscheduled basis by occupant intervention

Scope

Exterior Lighting Requirements:

Mandatory Requirements:
- Controls

Exterior Lighting Requirements:
- Energy Efficient Sources
- Use Limitations

Interior Lighting Power Table 805.4.2

TABLE 805.4.2
INTERIOR LIGHTING POWER

BUILDING OR AREA TYPE	ENTIRE BUILDING (W/ft^2)	TENANT AREA OR PORTION OF BUILDING (W/ft^2)
Auditorium	NA	1.6
Bank/financial institution[a]	NA	2.0
Classroom/lecture hall[b]	NA	1.6
Convention, conference or meeting center[a]	NA	1.5
Corridor, restroom, support area	NA	0.8
Dining[a]	NA	1.4
Exercise center[a]	1.4	1.1
Exhibition hall	NA	3.3
Grocery store[c]	1.9	2.1
Gymnasium playing surface	NA	1.9
Hotel function[a]	NA	2.4
Industrial work, < 20 ft ceiling height	NA	2.1
Industrial work, ≥ 20 ft ceiling height	NA	3.0
Kitchen	NA	2.2
Library[a]	1.5	1.8
Lobby—hotel[a]	NA	1.9
Lobby—other[a]	NA	1.0
Mall, arcade, or atrium	NA	1.4
Medical and clinical care[b, d]	1.6	1.6
Museum[b]	1.6	1.6
Office[b]	1.3	1.5
Religious worship[a]	2.2	3.2
Restaurant[a]	1.7	1.7
Retail sales, wholesale showroom[c]	1.9	2.1
School	1.5	NA
Storage, industrial and commercial	0.6	1.0
Theaters—motion picture	1.1	1.0
Theaters—performance[a]	1.4	1.5
Other	0.6	1.0

For SI: 1 foot = 304.8 mm, 1 W/ft^2 = $W/0.0929\ m^2$.

NA = Not Applicable.

a. Where lighting equipment is specified to be installed for decorative appearances in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the decorative lighting equipment or 1.0 W/ft^2 times the area of the space that the decorative lighting equipment is in shall be added to the interior lighting power determined in accordance with this line item.

b. Where lighting equipment is specified to be installed to meet requirements of visual display terminals as the primary viewing task, the smaller of the actual wattage of the lighting equipment or 0.35 W/ft^2 times the area of the space that the lighting equipment is in shall be added to the interior lighting power determined in accordance with this line item.

c. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or 1.6 W/ft^2 times the area of the specific display, or 3.9 W/ft^2 times the actual case or shelf area for displaying and selling fine merchandise such as jewelry, fine apparel and accessories, or china and silver, shall be added to the interior lighting power determined in accordance with this line item.

d. Where lighting equipment is specified to be installed, the smaller of the actual wattage of the lighting equipment, or 1.0 W/ft^2 times the area of the emergency, recovery, medical supply and pharmacy space shall be added to the interior lighting power determined in accordance with this line item.

Lighting Footnotes

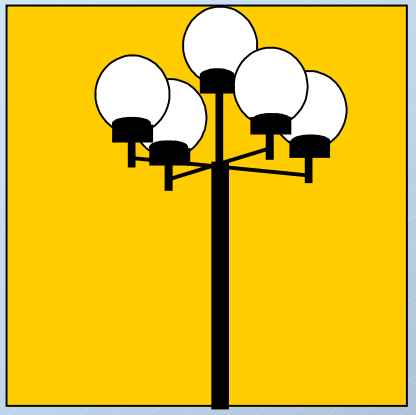
- Decorative Appearances
  - Switched or dimmed on separate circuits
  - Use the lesser of the wattage of decorative lighting or 1.0 w/ft^2 x area of space
- Visual Display Terminals
  - Use lesser of actual wattage of the lighting equipment or 0.35 w/ft^2 x area of space
- Merchandise
  - Switched or dimmed on separate circuits
  - Use lesser of actual wattage or 3.9 w/ft^2 x actual case of shelf area
- Medical or Clinical Care
  - Use lesser of actual wattage of lighting equipment or 1.0 w/ft^2 x designated area

Exterior Lighting

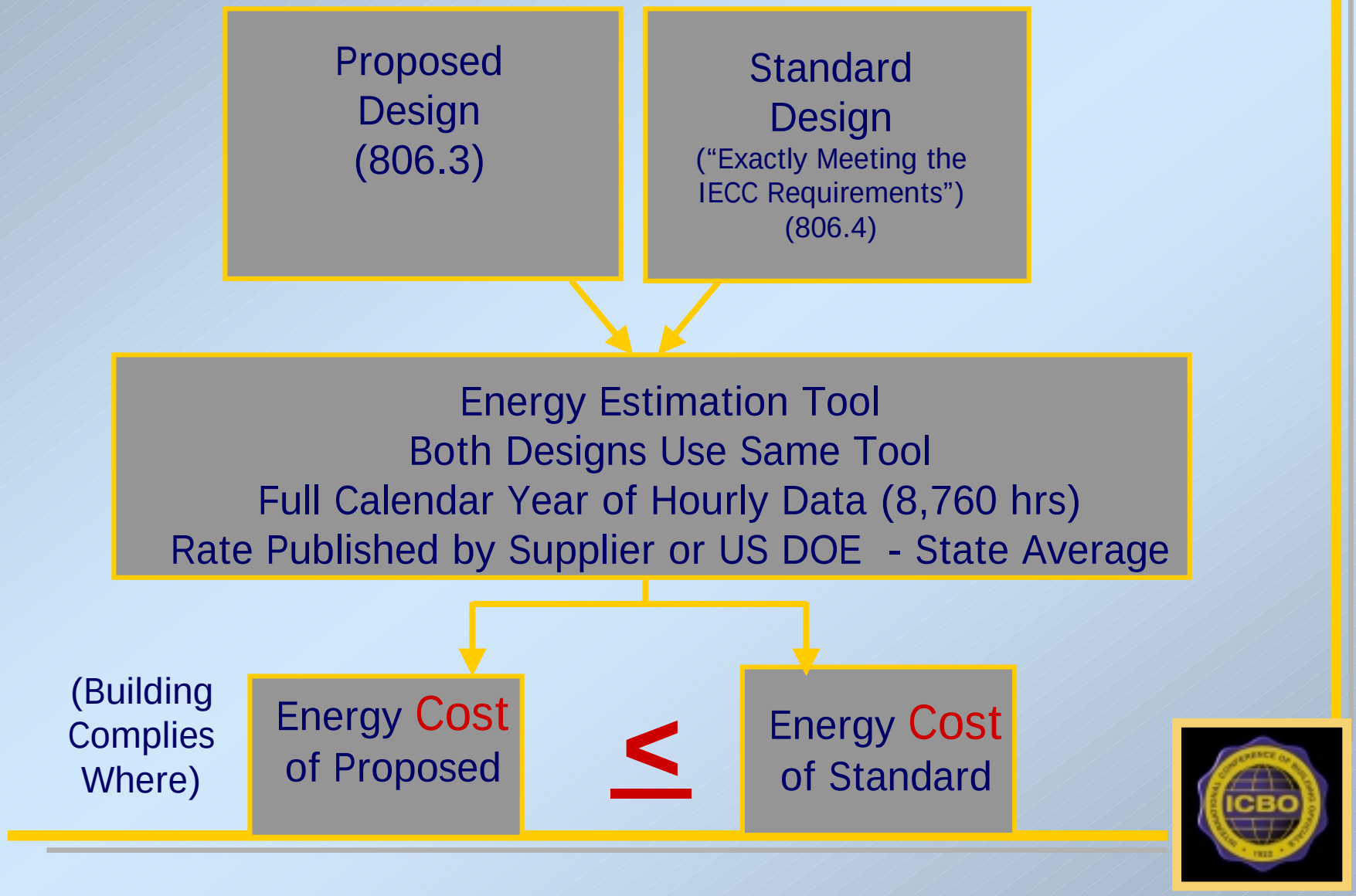
Criteria

- Lighting power supplied through building electrical service

- Must use energy-efficient lighting sources to highlight paths, walkways and parking areas
  - ≥ 45 Lumens/Watt
  - Fluorescent
  - Compact Fluorescent
  - Metal Halide
  - High Pressure Sodium



Total Building Performance



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- Chapter 9 Referenced Standards

What Types of Buildings Must Comply?

Multi family ≤ 3 stories

Detached one and two - family dwellings

Additions and Replacement Windows

TABLE 502.2.5
PRESCRIPTIVE ENVELOPE COMPONENT CRITERIA ADDITIONS TO AND REPLACEMENT WINDOWS FOR EXISTING TYPE A-1 RESIDENTIAL BUILDINGS

HEATING DEGREE DAYS	MAXIMUM	MINIMUM					
	Fenestration *U*-factor	Ceiling *R*-value[a]	Wall *R*-value	Floor *R*-value	Basement wall *R*-value[b]	Slab perimeter *R*-value and depth[c]	Crawl space wall *R*-value[d]
0 - 1,999	0.75	R-26	R-13	R-11	R-5	R-0	R-5
2,000 - 3,999	0.5	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
4,000 - 5,999	0.4	R-38	R-18	R-21	R-10	R-9, 2 ft.	R-19
6,000 - 8,499	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft.	R-20
8,500 - 12,999	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft.	R-20

For SI: 1 foot = 304.8 mm.

a. "Ceiling *R*-value" shall be required for flat or inclined (cathedral) ceilings. Floors over outside air shall meet "Ceiling *R*-value" requirements.

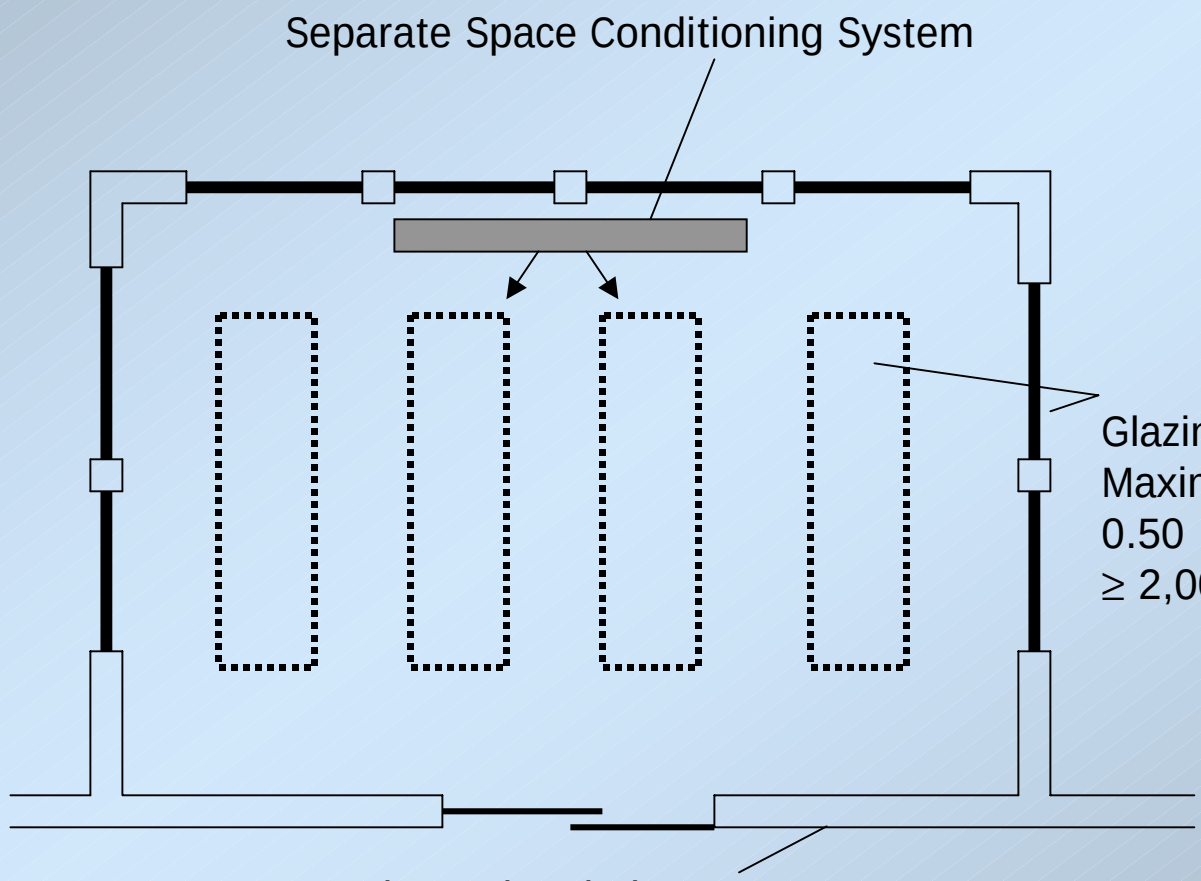
b. Basement wall insulation shall be installed in accordance with Section 502.2.1.6.

c. Slab perimeter insulation shall be installed in accordance with Section 502.2.1.4. An additional R-2 shall be added to "Slab perimeter *R*-value" in the table if the slab is heated.

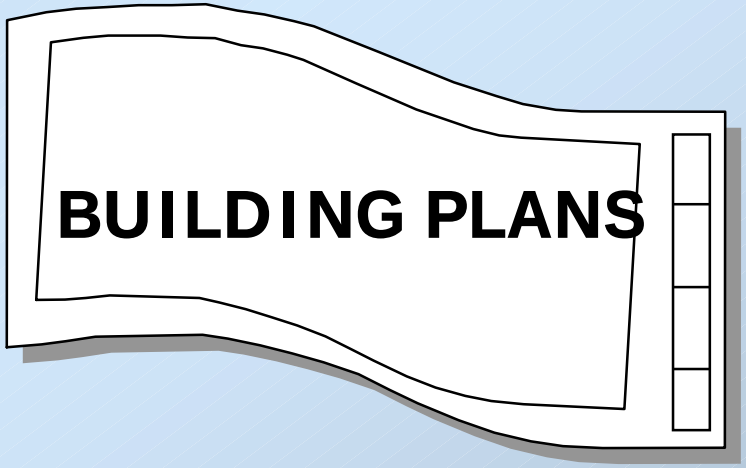
d. "Crawl space wall *R*-value" shall apply to unventilated crawl spaces only. Crawl space insulation shall be installed in accordance with Section 502.2.1.5.

- Replacement skylight U-factor 0.50 for locations > 1,999 HDD

Sunroom Addition

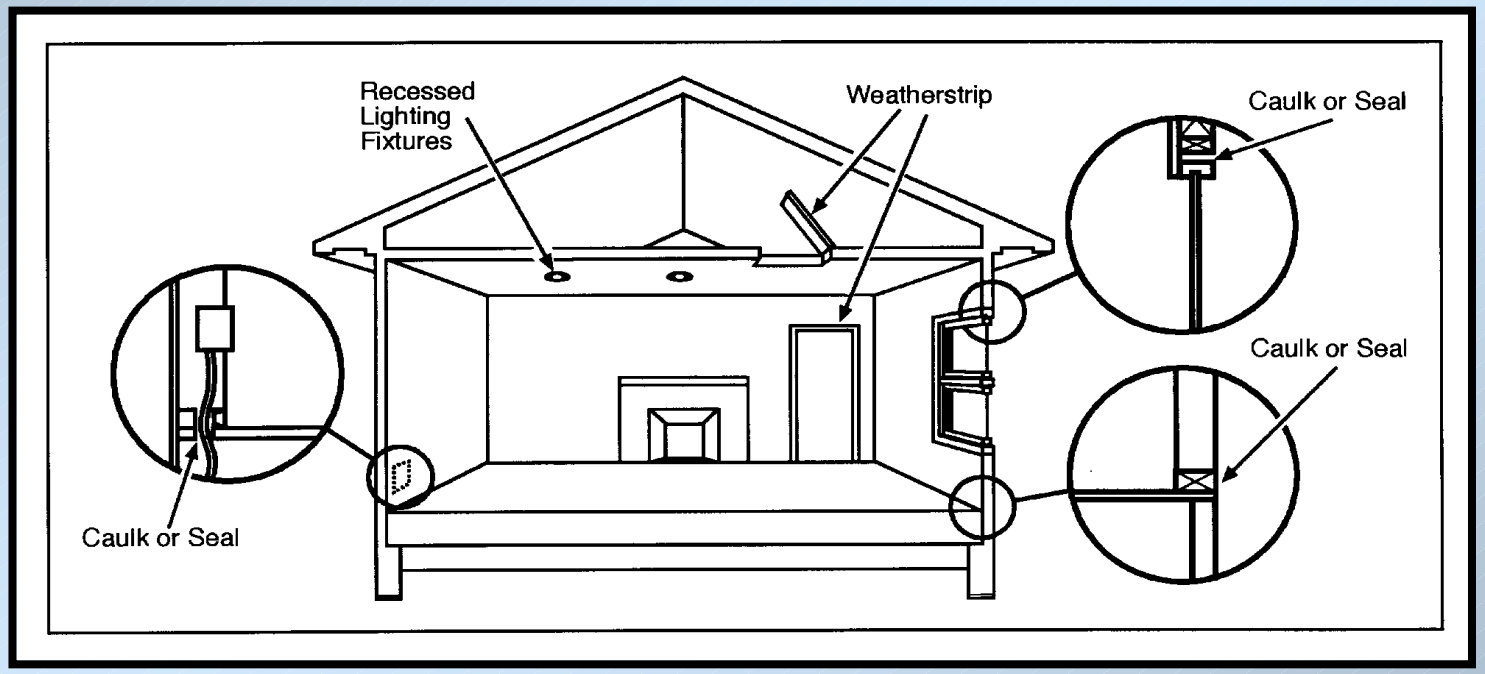


- Air Leakage
- Vapor Retarders
- Materials and Equipment Information
- Heating and Cooling Equipment Efficiencies
- Duct Insulation
- Duct Construction
- Temperature Controls
- HVAC Piping Insulation
- Swimming Pools
- Circulating Service Hot Water Systems
- Electrical



Basic Requirements

- Infiltration Controls
  - Seal all joints, penetrations and other such openings in the building envelope

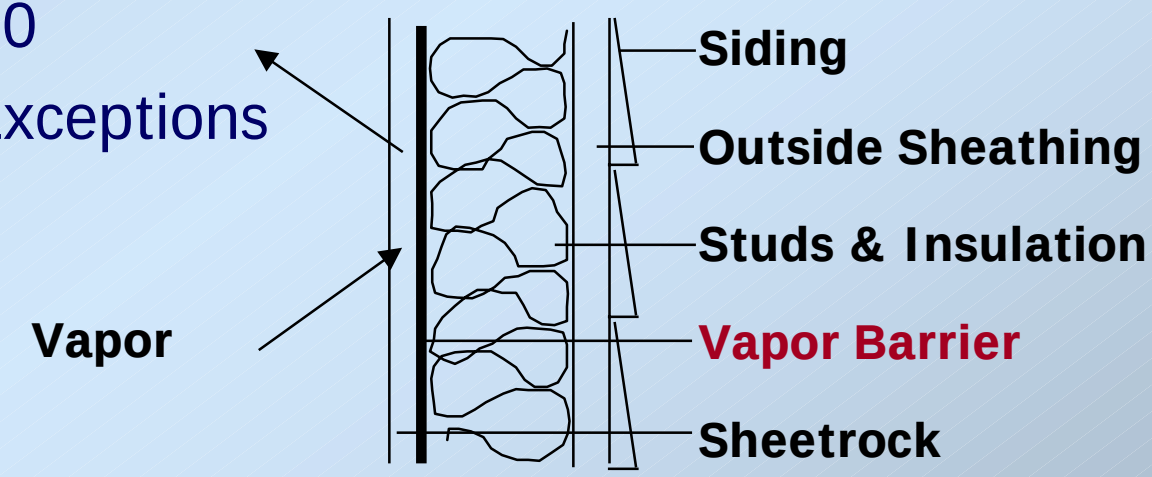


Infiltration Controls

Air Tight Recessed Fixture

Basic Requirements

- Vapor retarders
  - Install on “warm-in-winter side” of insulation
  - Use in unvented framed walls, floors, and ceilings
  - Must have Perm rating of ≤ 1.0 per ASTM E96-80
  - Exceptions



Basic Requirements

Vapor Retarders

- Exception 3:

“Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities are provided.”

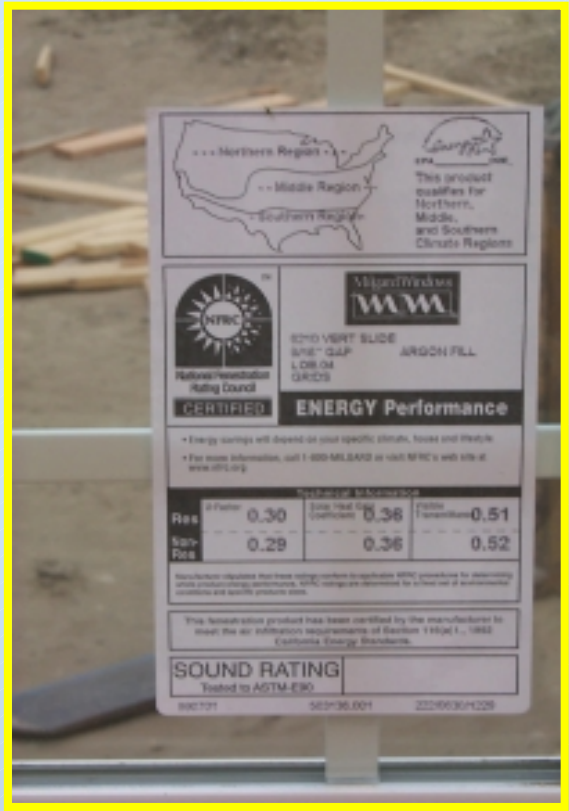
Vapor Retarders - One Option

Vapor Retarders

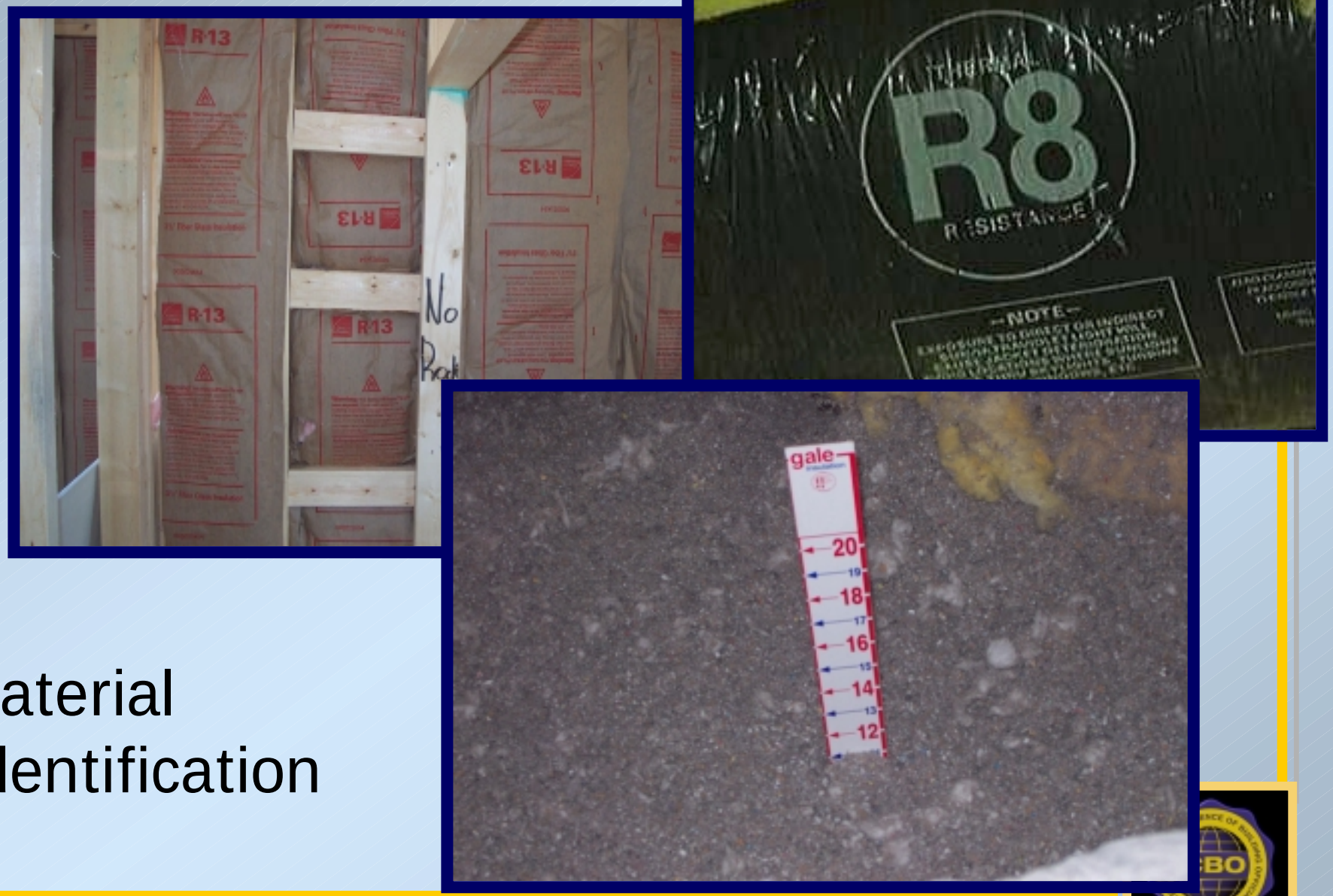
- **<u>Another Example</u> – Kraft Faced Vapor Barrier**

Fenestration U-factor Requirements

- NFRC Rating for all Manufactured Fenestration; or
- Tables 102.5.2(1) U-factor Default Table for Windows, Glazed Doors and Skylights

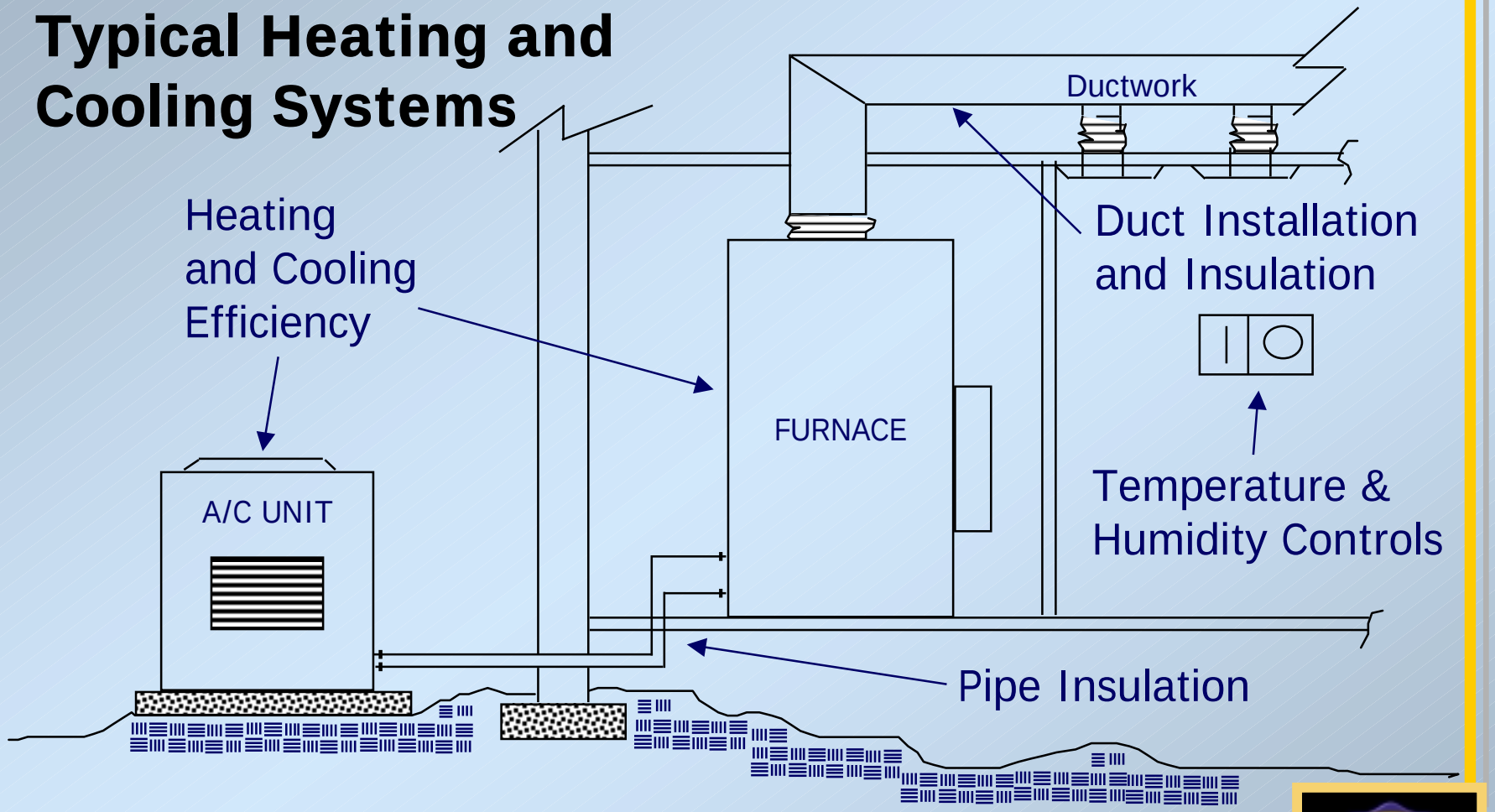


Material Identification



HVAC Systems

Typical Heating and Cooling Systems



Duct Insulation Requirements

	Insulation R-values (h•ft^2•^{o}F)/Btu[d]			
	Ducts in unconditioned attics or outside building		Ducts in unconditioned basements, crawl spaces, garages and other unconditioned spaces[c]	
	Supply	Return	Supply	Return[b]
Annual Heating Degree Days				
Below 1,500	8	4	4	0
1,500 to 3,500	8	4	6	2
3,501 to 7,500	8	4	8	2
Above 7,500	11	6	11	2

HVAC Duct Insulation

Duct Systems
Air Sealing

HVAC Duct Sealing

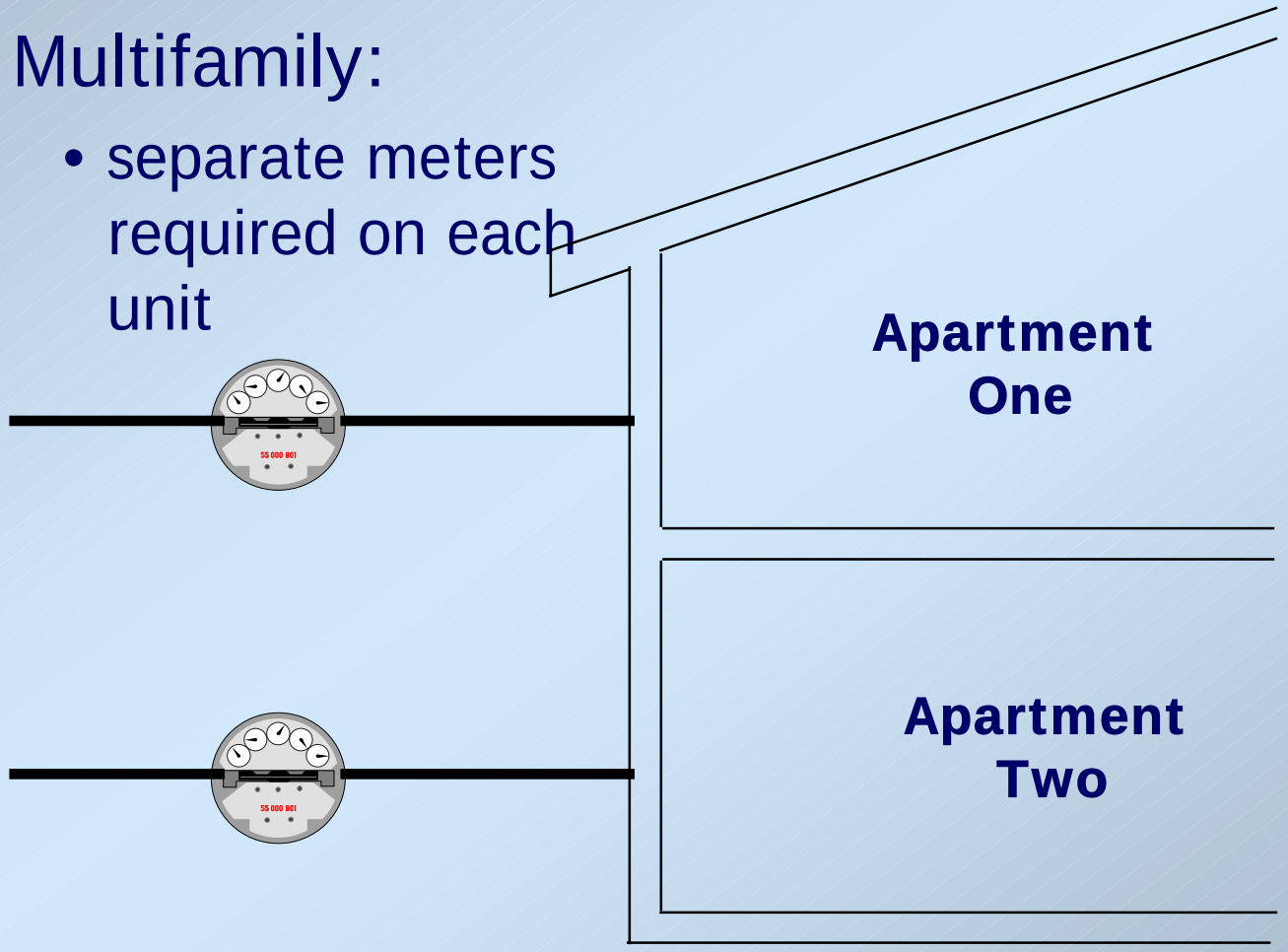
HVAC Duct Sealing

HVAC Duct Sealing

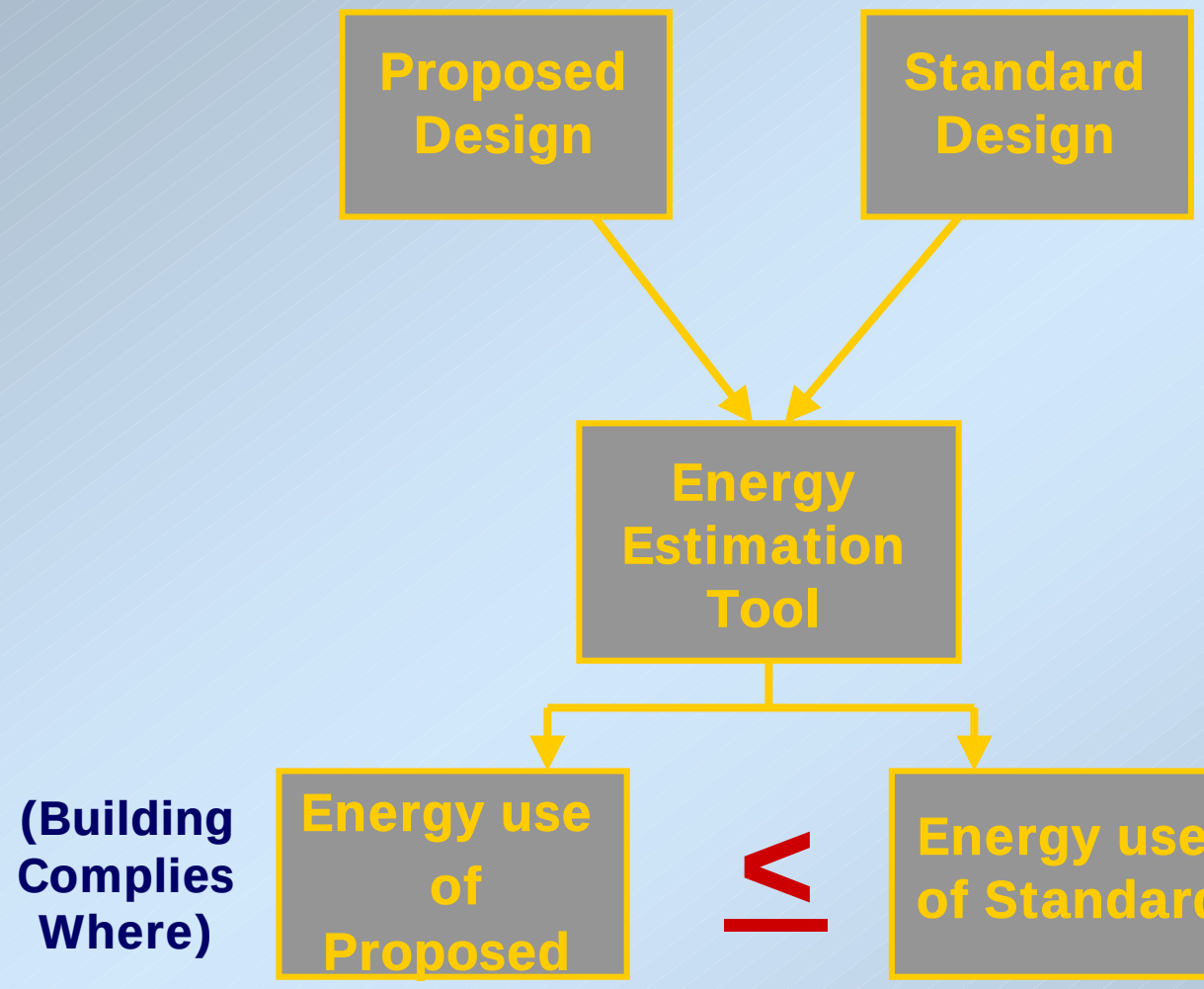
HVAC Duct Sealing

Electrical Systems

- Electrical metering
  - Multifamily:
    - separate meters required on each unit



Chapter 4 -Design By Systems Analysis



(Building Complies Where)

Chapter 5: How are the requirements for Insulation and Windows determined ?

TABLE 502.2.4(3)
PRESCRIPTIVE BUILDING ENVELOPE REQUIREMENTS, TYPE A-1 RESIDENTIAL BUILDINGS
WINDOW AREA 15 PERCENT OF GROSS EXTERIOR WALL AREA

HEATING DEGREE DAYS	MAXIMUM	MINIMUM					
	Glazing *U*-factor	Ceiling *R*-value	Exterior wall *R*-value	Floor *R*-value	Basement wall *R*-value	Slab perimeter *R*-value and depth	Crawl space wall *R*-value
0-499	any	R-13	R-11	R-11	R-0	R-0	R-0
500-999	0.90	R-19	R-11	R-11	R-0	R-0	R-4
1,000-1,499	0.75	R-19	R-11	R-11	R-0	R-0	R-5
1,500-1,999	0.75	R-26	R-13	R-11	R-5	R-0	R-5
2,000-2,499	0.65	R-30	R-13	R-11	R-5	R-0	R-6
2,500-2,999	0.60	R-30	R-13	R-19	R-6	R-4, 2 ft.	R-7
3,000-3,499	0.55	R-30	R-13	R-19	R-7	R-4, 2 ft.	R-8
3,500-3,999	0.50	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
4,000-4,499	0.45	R-38	R-13	R-19	R-8	R-5, 2 ft.	R-11
4,500-4,999	0.45	R-38	R-16	R-19	R-9	R-6, 2 ft.	R-17
5,000-5,499	0.45	R-38	R-18	R-19	R-9	R-6, 2 ft.	R-17
5,500-5,999	0.40	R-38	R-18	R-21	R-10	R-9, 2 ft.	R-19
6,000-6,499	0.35	R-38	R-18	R-21	R-10	R-9, 4 ft.	R-20
6,500-6,999	0.35	R-49	R-21	R-21	R-11	R-11, 4 ft.	R-20
7,000-8,499	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft.	R-20
8,500-8,999	0.35	R-49	R-21	R-21	R-18	R-14, 4 ft.	R-20
9,000-12,999	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft.	R-20

For SI: 1 foot = 304.8 mm.

Prescriptive Specification

Percent of Gross Exterior Wall Area:

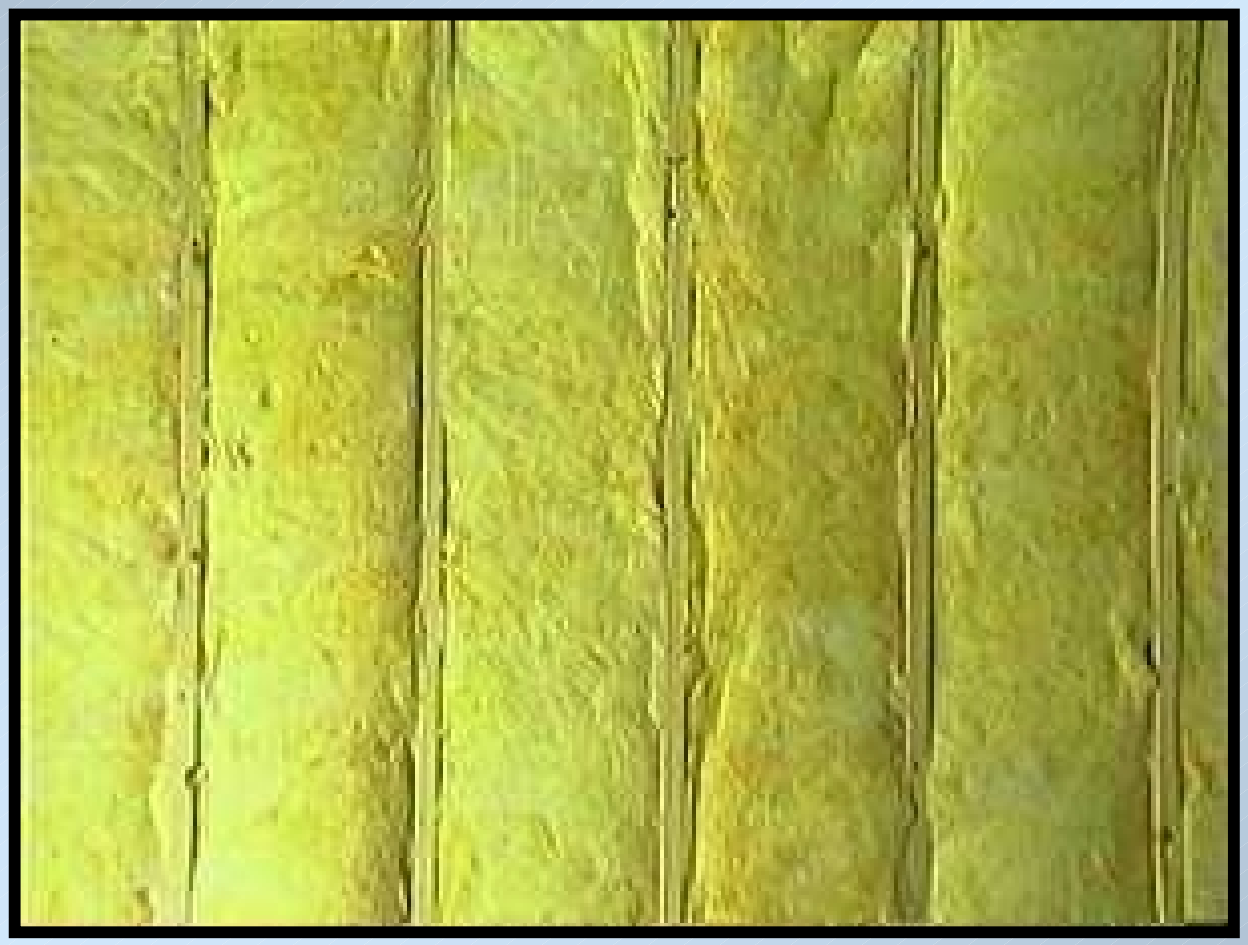
- **Wall area shall be gross area of exterior walls**
- **Window area percent =**

$$\frac{\text{Window Area}}{\text{Gross Area of Exterior Walls}} \times 100$$

Raised Heel Trusses

Wall Insulation

Wall Insulation



Corner Framing

Ladder Framing

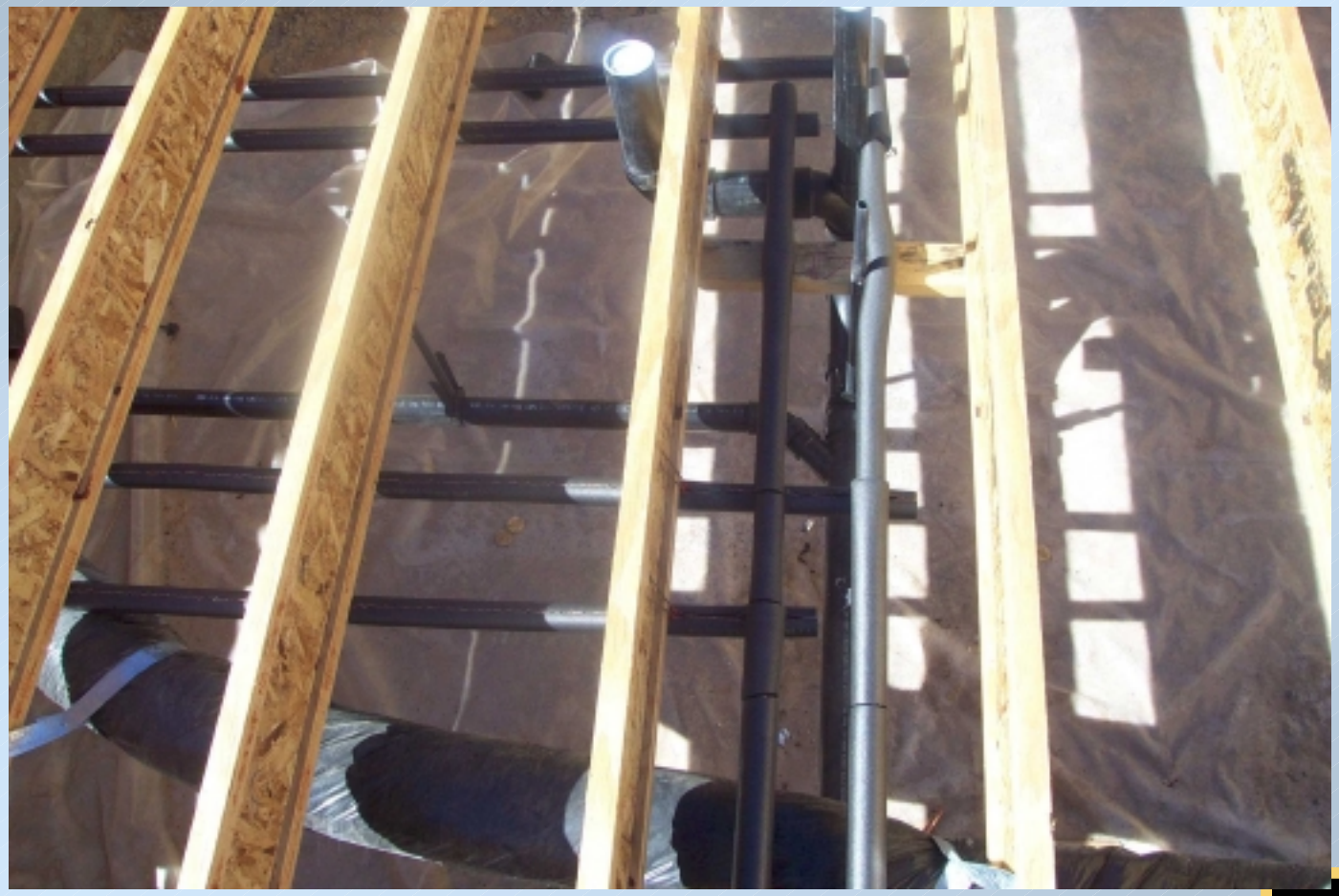
Wall Insulation

Slab Edge Insulation

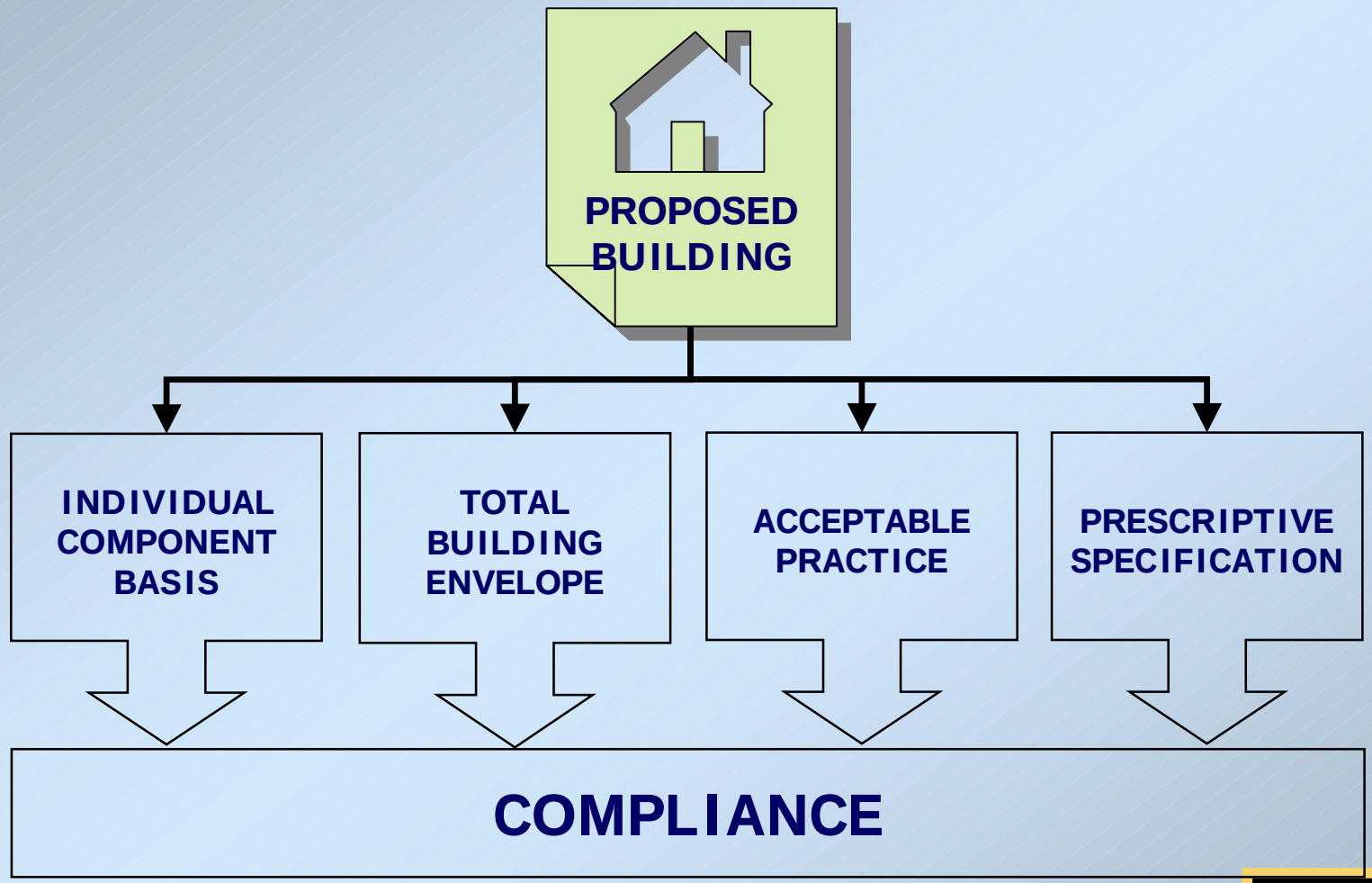
Crawlspace Wall Insulation

- Requirements
  - No ventilation openings allowed
  - Solution (*IRC Section R408*)
    - Provide continuously operating mechanical ventilation at 1 CFM/50ft^2; or
    - Provide conditioned air to crawlspace

Crawlspace Wall Insulation



Chapter 5: Component Performance



Chapter 6: Simplified Prescriptive

- Residential Buildings, Detached One and Two Family
  - Glazing must be less than 15% of gross wall area
- Multi-Family 3 Stories or Less
  - Glazing must be less than 25% of gross wall area

Chapter 6

Simplified Prescriptive Requirements:

TABLE 602.1
SIMPLIFIED PRESCRIPTIVE BUILDING ENVELOPE THERMAL COMPONENT CRITERIA
MINIMUM REQUIRED THERMAL PERFORMANCE (*U*-FACTOR AND *R*-VALUE)

	Maximum	Minimum					
HEATING DEGREE DAYS	Glazing *U*-factor	Ceiling *R*-value	Wall *R*-value	Floor *R*-value	Basement wall *R*-value	Slab perimeter *R*-value and depth	Crawl space wall *R*-value
0-499	Any	R-13	R-11	R-11	R-0	R-0	R-0
500-999	0.90	R-19	R-11	R-11	R-0	R-0	R-4
1,000-1,499	0.75	R-19	R-11	R-11	R-0	R-0	R-5
1,500-1,999	0.75	R-26	R-13	R-11	R-5	R-0	R-5
2,000-2,499	0.65	R-30	R-13	R-11	R-5	R-0	R-6
2,500-2,999	0.60	R-30	R-13	R-19	R-6	R-4, 2 ft.	R-7
3,000-3,499	0.55	R-30	R-13	R-19	R-7	R-4, 2ft.	R-8
3,500-3,999	0.50	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
4,000-4,499	0.45	R-38	R-13	R-19	R-8	R-5, 2 ft.	R-11
4,500-4,999	0.45	R-38	R-16	R-19	R-9	R-6, 2 ft.	R-17
5,000-5,499	0.45	R-38	R-18	R-19	R-9	R-6, 2 ft.	R-17
5,500-5,999	0.40	R-38	R-18	R-21	R-10	R-9, 4 ft.	R-19
6,000-6,499	0.35	R-38	R-18	R-21	R-10	R-9, 4 ft.	R-20
6,500-6,999	0.35	R-49	R-21	R-21	R-11	R-11, 4 ft.	R-20
7,000-8,499	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft.	R-20
8,500-8,999	0.35	R-49	R-21	R-21	R-18	R-14, 4 ft.	R-20
9,000-12,999	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft.	R-20

For SI: 1 foot = 304.8 mm.